

<b>AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT</b>				1. Contract ID Code Firm-Fixed-Price		Page 1 Of 6	
2. Amendment/Modification No.  P00001		3. Effective Date  2004JUN25		4. Requisition/Purchase Req No.  SEE SCHEDULE		5. Project No. (If applicable)	
6. Issued By TACOM WARREN AMSTA-AQ-ABGD PHILLIP LAWRENCE (586)574-5273 WARREN, MICHIGAN 48397-5000 HTTP://CONTRACTING.TACOM.ARMY.MIL EMAIL: LAWRENCPT@TACOM.ARMY.MIL		Code W56HZV		7. Administered By (If other than Item 6) DCMA DETROIT U.S. ARMY TANK & AUTOMOTIVE COMMAND (TACOM) ATTN: DCMAE-GJD WARREN, MI 48397-5000		Code S2305A	
				SCD C PAS NONE ADP PT HQ0337			
8. Name And Address Of Contractor (No., Street, City, County, State and Zip Code)  REALTIME TECHNOLOGIES, INC. 1517 N. MAIN STREET ROYAL OAK, MI. 48067-1319  TYPE BUSINESS: Other Small Business Performing in U.S.				<input type="checkbox"/>		9A. Amendment Of Solicitation No.	
				<input type="checkbox"/>		9B. Dated (See Item 11)	
				<input checked="" type="checkbox"/>		10A. Modification Of Contract/Order No.  DAAE07-03-P-L081	
				<input type="checkbox"/>		10B. Dated (See Item 13)  2003SEP22	
Code 1R5H6		Facility Code					
<b>11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS</b>							
<input type="checkbox"/> The above numbered solicitation is amended as set forth in item 14. The hour and date specified for receipt of Offers <input type="checkbox"/> is extended, <input type="checkbox"/> is not extended. Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendments: (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. <b>FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER.</b> If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.							
12. Accounting And Appropriation Data (If required) NO CHANGE TO OBLIGATION DATA							
<b>13. THIS ITEM ONLY APPLIES TO MODIFICATIONS OF CONTRACTS/ORDERS</b>							
KIND MOD CODE: B It Modifies The Contract/Order No. As Described In Item 14.							
<input type="checkbox"/> A. This Change Order is Issued Pursuant To: The Changes Set Forth In Item 14 Are Made In The Contract/Order No. In Item 10A.							
<input checked="" type="checkbox"/> B. The Above Numbered Contract/Order Is Modified To Reflect The Administrative Changes (such as changes in paying office, appropriation data, etc.) Set Forth In Item 14, Pursuant To The Authority of FAR 43.103(b).							
<input type="checkbox"/> C. This Supplemental Agreement Is Entered Into Pursuant To Authority Of:							
<input type="checkbox"/> D. Other (Specify type of modification and authority)							
E. IMPORTANT: Contractor <input type="checkbox"/> is not, <input checked="" type="checkbox"/> is required to sign this document and return _____ copies to the Issuing Office.							
14. Description Of Amendment/Modification (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)  SEE SECOND PAGE FOR DESCRIPTION							

Except as provided herein, all terms and conditions of the document referenced in item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. Name And Title Of Signer (Type or print)		16A. Name And Title Of Contracting Officer (Type or print) MICHAEL CIONI CIONIM@TACOM.ARMY.MIL (586)574-7070	
15B. Contractor/Offeror  _____ (Signature of person authorized to sign)	15C. Date Signed	16B. United States Of America  By _____ /SIGNED/ (Signature of Contracting Officer)	16C. Date Signed  2004JUN25

NSN 7540-01-152-8070

PREVIOUS EDITIONS UNUSABLE

30-105-02

STANDARD FORM 30 (REV. 10-83)

Prescribed by GSA FAR (48 CFR) 53.243

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SUPPLEMENTAL INFORMATION

1. This is a bilateral modification. In accordance with the "Changes Clause" of contract DAAE07-03-P-L081, the contract is revised as follows:

Section B, is revised to reflected a completion date of 30 Oct 04.

Section C of the contract is deleted and replaced with the attached Section C in which paragraphs C.7 - C.7.2 are revised.

2. The Contractor agrees that the changes to Section C of the contract incorporated by this modification shall be at no additional cost to the Government.

3. As a result of this action the total contract price is neither increased nor decreased. All other terms and conditions of contract DAAE08-03-P-L081 as previously modified are in full force and effect.

\*\*\* END OF NARRATIVE A 001 \*\*\*

Name of Offeror or Contractor: REALTIME TECHNOLOGIES, INC.

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT
0001AF	<div>SUPPLIES OR SERVICES AND PRICES/COSTS</div> <div>SERVICES LINE ITEM</div> <div>NOUN: GVSL/MATREX PROJECT PRON: E132C447EH    PRON AMD: 02    ACRN: AA AMS CD: 63300154511</div> <div>Payment for paragraph C.4.4 and paragraphs C.7- C.7.2</div> <div>(End of narrative B002)</div> <div>Inspection and Acceptance INSPECTION: Destination    ACCEPTANCE: Destination</div> <div>Deliveries or Performance DLVR SCH    PERF COMPL REL CD    QUANTITY    DATE 001    0    30-OCT-2004</div> <div>\$ 14,784.00</div>				\$ 14,784.00

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**Name of Offeror or Contractor:** REALTIME TECHNOLOGIES, INC.

DESCRIPTION/SPECIFICATIONS/WORK STATEMENT

Statement of Work (SOW)

C.1 Background: Under this purchase order (PO), the contractor will provide software required for the TARDEC Ground Vehicle Simulation Laboratory (GVSL) involvement in the Modeling Architecture for Technology, Research, and Experimentation (MATREX) project. The GVSL is providing a distributed ground mobility modeling capability to the MATREX program. A baseline capability exists in the form of the GVSLs Vehicle Dynamics and Mobility Server (VDMS). The baseline capability will be enhanced and improved by the contractor hereunder, in the areas defined in this Statement of Work (SOW).

C.1.1 Acronyms and Definitions: The following terms appear in the SOW and are defined here for reference.

- a. TARDEC Tank Automotive Research, Development and Engineering Center.
- b. GVSL Ground Vehicle Simulation Laboratory. The TARDEC GVSL is the proponent organization for this SOW.
- c. MATREX Modeling Architecture for Technology, Research, and Experimentation. This is an Army Science and Technology Objective (STO) to develop an architecture for distributed simulation. The work described in this SOW is in support of the MATREX STO.
- d. VDMS Vehicle Dynamics and Mobility Server. This is a ground platform model with embedded terrain and driver models, which is being developed for use in the MATREX STO. A baseline VDMS capability exists within the GVSL, with a baseline implementation of the ACA (defined below) and a baseline implementation of the VDMM. Source code is available from the COR for each of these components and for the entire VDMS software package (see C.2).
- e. VDMM Vehicle Dynamics and Mobility Model. This is the ground platform model used by VDMS. VDMM is a software module that utilizes the General Vehicle Dynamics Interface (GVDI), a standard interface used by all GVSL real-time vehicle models. The GVDI Version 2.0 specification document is available from the Contracting Officer Representative (COR) (see C.2).
- f. ACA Autonomous Control Algorithm. This is the driver model used by VDMS. The ACA uses waypoint or desired velocity vector descriptions and current vehicle state information in order to generate throttle, steer, brake, and gear settings that are then used as input values to VDMM.
- g. Waypoint Waypoint control is the method of defining a location to move to and a measure of how fast the vehicle should travel in order to arrive at the given location. Terms included in this SOW related to waypoint descriptions include:
- h. Waypoint Location The desired location to move to.
- i. Waypoint Orientation The desired orientation to assume at the waypoint.
- j. Waypoint threshold A distance that defines a radius around a certain waypoint within which the vehicle should consider the waypoint to be reached. This value is variable and may change with each individual waypoint.
- k. Path Deviation Threshold A distance that indicates the maximum deviation allowed from a straight line between the last achieved waypoint and the current waypoint. This value is variable and may change with each individual waypoint.
- l. Route A route is defined as a series of waypoints. Waypoint control may be implemented using a single waypoint, or by specifying a series of waypoints (route) to be reached in order.

C.2 All Government Furnished Information (GFI) (software or data) identified in this SOW is available from the COR for use within the GVSL or at the contractor's site. A request for any GFI software or data must be made to the COR through email. The COR will provide the GFI within seven days of the request. Transfer of GFI to the contractor's site will be made through email or by CD-ROM. The GFI may be only be used in the fulfillment of this SOW and must be returned to the COR upon completion of this SOW.

C.3 Software delivered by the contractor under this contract shall be delivered on a permanently labeled CD-ROM to the COR and must include source code and precompiled libraries for the target machine: RedHat Linux 7.3 base system with the 2.420 kernel and RTLinuxFREE GPL libraries. The target machine is available for contractor's use at the GVSL and instructions for configuring a machine are available for development work at the contractor's site. On-site access to the target machine must be requested from the COR at least twenty-four hours ahead of time in order to guarantee availability.

C.3.1 Run-time execution speeds for software developed under this contract must be such that real-time execution is possible on the target machine.

C.4 Coordinate Conversion Software

C.4.1 Within 21 days of award of this purchase order, the contractor shall deliver coordinate conversion source code to convert to and from a local SAE Cartesian Coordinate system and a Geocentric Coordinate System. Within 21 days of award of this purchase order, the contractor shall integrate the coordinate conversion libraries into the top level Vehicle Dynamics and Mobility Server (VDMS) software.

C.4.1.1 Within 18 days of award of this purchase order, the contractor shall define a test to verify the coordinate conversion and verbally present the plan to the COR for approval. Upon approval by the COR, the test shall be implemented and executed on target hardware at the GVSL in the presence of the COR, or other government personnel identified by the COR in the event the COR is not available.

C.4.2 Within 21 days of award of this purchase order, the contractor shall deliver coordinate conversion source code to convert to and from a local SAE Cartesian Coordinate system and a Geodetic Coordinate System. Within 21 days of award of this purchase order, the contractor shall integrate the coordinate conversion libraries into the top level Vehicle Dynamics and Mobility Server (VDMS) software.

C.4.2.1 Within 18 days of award of this purchase order, the contractor shall define a test to verify the coordinate conversion and verbally present the plan to the COR. Upon approval by the COR, the test shall be implemented and executed on target hardware at the GVSL in the presence of the COR, or other government personnel identified by the COR in the event the COR is not available.

C.4.3 Within 90 days of award of this purchase order, the contractor shall deliver coordinate conversion source code to convert to and from a local SAE Cartesian Coordinate system and a Universal Transverse Mercator (UTM) Coordinate System. Within 90 days of award of this purchase order, the contractor shall integrate the coordinate conversion libraries into the top level Vehicle Dynamics and Mobility

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Server (VDMS) software and into the GVSL terrain interrogation code.

C.4.3.1 Within 85 days of award of this purchase order, the contractor shall define a test to verify the coordinate conversion and verbally present to the COR. Upon approval by the COR, the test shall be implemented and executed on target hardware at the GVSL in the presence of the COR, or other government personnel identified by the COR in the event the COR is not available.C.4.4

C.4.4 Within 180 days of award of this purchase order, the contractor shall deliver coordinate conversion source code to convert to and from a local SAE Cartesian Coordinate system and a Global Coordinate System. Information of the definition of the Global Coordinate System is available from the COR. Within 180 days of award of this purchase order, the contractor shall integrate the coordinate conversion libraries into the top level Vehicle Dynamics and Mobility Server (VDMS) software and into the GVSL terrain interrogation code.

C.4.4.1 Within 175 days of award of this purchase order, the contractor shall define a test to verify the coordinate conversion and verbally present to the COR. Upon approval by the COR, the test shall be implemented and executed on target hardware at the GVSL in the presence of the COR, or other government personnel identified by the COR in the event the COR is not available.

C.5 Autonomous Control Algorithm (ACA) Software

C.5.1 Within 21 days after the award of this purchase order, the contractor shall deliver an initial ACA software package that provides the capability to follow a desired translational velocity vector.

The desired velocity vector will be updated at a 2Hz rate and will be input to the ACA at runtime.

C.5.1.1 Within 18 days of award of this purchase order, the contractor shall define a test to verify the coordinate conversion and verbally present to the COR. Upon approval by the COR, the test shall be implemented and executed on target hardware at the GVSL in the presence of the COR, or other government personnel identified by the COR in the event the COR is not available.

C.5.2 Within 120 days after the award of this purchase order, the contractor shall deliver an enhanced ACA software package that provides, in addition to the capabilities already added per C.5.1, the capability to:

- (a) move towards a single waypoint at a rate defined by a desired maximum speed enroute to waypoint,
- (b) shift gears (Park, Neutral, Reverse, and Drive),
- (c) assume an orientation upon reaching a waypoint, and
- (d) maintain a course within the Path Deviation Threshold.

The desired speed, orientation and the Path Deviation Threshold will be data included within the waypoint description received by the ACA at runtime. The ACA software must be able to achieve waypoints that cause turning angles of less than 90 degrees and waypoints that are spaced one millimeter to one kilometer apart.

C.5.2.1 Within 115 days of award of this purchase order, the contractor shall execute the test suite defined in section C.9.1. on target hardware at the GVSL in the presence of the COR, or other government personnel identified by the COR in the event the COR is not available.

C.5.3 Within 150 days of the award of this purchase order, the contractor shall deliver a final ACA software package that, in addition to incorporating the capabilities required by C.5.1 and C.5.2, also provides optimizations in the areas of near-waypoint behavior and the ability to use route information, as opposed to single waypoints, for path planning.

C.5.3.1 Within 145 days of the award of this purchase order, the contractor shall execute the test suite defined in section C.9.1 in the GVSL laboratory in the presence of the COR, or other government personnel identified by the COR in the event the COR is not available.

C.6 Vehicle Dynamics and Mobility Model (VDMM) Software

C.6.1 Within 30 days after the award of this purchase order, the contractor shall examine the GFI terrain database (Caspian Sea) and identify terrain features that affect vehicle behavior (rivers, canals, structures including buildings and bridges) and information contained in the database that is associated with these features.

C.6.1.1 Within 45 days after the award of this purchase order, the contractor shall design and implement a method by which vehicle model performance is affected by terrain features identified above. The effects of terrain features on vehicle model performance do not need to be implemented using physics-based models, but should be structured for reuse in future physics-based models (i.e. performance effects do not require validation - rough behavior suffices - a 1 foot stream slows down a vehicle, while a 20 foot river stops a vehicle).

C.6.1.2 Within 45 days after the award of this purchase order, the contractor shall modify an 8x8 vehicle model (previously delivered by contractor under contract number DAAE07-98-C-L012, work directive #NAC 002) to include the effects of terrain features on mobility performance, as identified in C.6.1.1.

C.6.1.3 Within 120 days after the award of this purchase order, the contractor shall modify 4x4 and 6x6 vehicle models (previously delivered by contractor under contract number DAAE07-98-C-L012, work directive #NAC 002) to include the effects of terrain features on mobility performance, as identified in C.6.1.1

C.6.2 Within 120 days after the award of this purchase order, the contractor shall identify and implement modifications to the GVSL vehicle interface specification required in order to incorporate fuel consumption parameters. The intended result of adding fuel consumption capabilities is to provide the interfaces required for future, physics-based fuel consumption estimates.

C.6.2.1 Within 120 days after the award of this purchase order, the contractor shall modify 4x4, 6x6, and 8x8 vehicle models (previously delivered under contract number DAAE07-98-C-L012, work directive #NAC 002) to include an estimate of fuel consumption as per C.6.2 above. Fuel consumption estimates are not restricted to rigorous physical modeling, but should represent at least a roughly accurate estimate of fuel consumption.

C.6.3 Within 85 days after the award of this purchase order, the contractor shall execute the test suite defined in section C.9.1 in the GVSL laboratory in the presence of the COR, or other government personnel identified by the COR in the event the COR is not available.

C.7 The Contractor shall provide the 8x8 computer model (described in section C.6.2.1 of this contract) and a simplified mobility model (described in in section C.7.2 below) to the Government for use in the TARDEC VETRONICS Technology Area embedded simulation system and provide support for the models as described in section C.7.1. The models shall be delivered in source code by email to the COR.

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**Name of Offeror or Contractor:** REALTIME TECHNOLOGIES, INC.

C.7.1 The contractor will provide support on the 8x8 and bicycle model as follows: government personnel will integrate, compile, and execute the models within the embedded simulation system. Problems will be identified by government personnel and described in email to the contractor. The contractor will examine the problem and provide, by email to the COR, a suggested solution within seven days. If the suggested solution involves modifications to the 8x8 or simplified mobility models' source code and the COR approves the change, the contractor shall then implement the suggested solution within 7 days after approval. If the suggested solution is not approved by the COR, the contractor will suggest alternative approaches, within seven days, that may be implemented by government personnel. If the suggested solution involves changes external to the models, then government personnel will implement the changes. Support effort will be limited to eighty (80) hours of contractor effort.

C.7.2 The simplified mobility model is a model that captures gross mobility information (position, velocity, and acceleration) of the vehicle chassis, but does not include internal body locations. The intention is to have the capability to run a larger number of models on a single computer processor than is possible with the 8x8 mobility model described in section 6.2.1.

C.8.1 Within 90 days after the award of this purchase order, the contractor shall provide two permanent run-time licenses for the contractor's GVDS vehicle dynamics software. The software will be provided to the COR on a CD-ROM along with license information.

C.9 Internal Verification and Validation

C.9.1 Within 90 days of award of this purchase order, the contractor shall design and implement a test suite for VDMS that may be used to verify and validate ACA and VDMM functional behavior. The test suite must be implemented in software and executed by a command line argument supplied to VDMS at program startup. The following maneuvers, as a minimum, must be implemented using the ACA waypoint control methods provided under this purchase order (i.e. vehicle path and speed for each test must be defined by a waypoint route):

- a. Straight line acceleration / deceleration
- b. Double lane change
- c. Circle test with increasing speed
- d. Circle test with decreasing radius
- e. J-Turn
- f. Four 90 degree right turns at 50% of top speed
- g. Four 90 degree left turns at 50% of top speed
- h. Complete single lap of Churchville B course
- i. Fuel Economy Test of Contractor's Design
- j. Soft-soil Mobility Test of Contractor's Design.

\*\*\* END OF NARRATIVE C 001 \*\*\*